AMBER model 5500

PROGRAMMABLE AUDIO MEASUREMENT SYSTEM

OWNER'S MANUAL

# SECTION 1

# GENERAL INFORMATION

Issue 07 January 1989

# 1.0 GENERAL OVERVIEW

The model 5500 is a complete stimulus/measurement system and contains both a programmable generator and a comprehensive level/noise/distortion meter. Although they share the same enclosure and front panel, there is little connection between the transmitter (generator) and the receiver (level/noise/distortion meter). Each section is autonomous and does not necessarily have to operate with its internal mate.

The front panel controls for the meter are generally on the left while those for the generator are generally on the right. In most cases, operating controls for the meter will not affect the generator and vice versa (an exception is IMD and NARROW BAND LEVEL discussed in detail later).

Two numeric displays are provided on the front panel. These generally indicate measured values provided by the meter section but can be changed to indicate user programmed values of the generator section. In addition, the right hand display doubles as a keyboard entry indicator while data is being entered. At the conclusion of manual data entry, the right display returns to its previous function (indicating measured input frequency).

Meter inputs are on the left and generator outputs on the right of the front panel. Two monitor outputs are also provided on the left for an external oscilloscope or additional processing. The rear panel contains AC mains input, GPIB port, optional serial port and possibly auxiliary signal inputs and outputs.

The displays are also used to inform the user of error conditions. These may be due to improper keyboard operation, incorrect input signals for a particular function or other errors. The error code number informs the operator of the nature of the error and its likely cause.

Some keys on the front panel have more than one function. The primary function is indicated with a beige label above the key. The secondary function, if there is one, is indicated in green below the key. To operate the secondary or "shift" function, the operator pushes and holds the green SHIFT key while pushing the desired function key. The SHIFT key may not lock but be active only while being pushed. When released, all keys revert to their normal (beige) functions. (See Section 6 for information on how to convert the SHIFT key into a "prefix" key.)

## 1.1 DISPLAYS

Two displays are provided. The left hand display generally indicates a measured value of the function selected. For example, AC millivolts (mV) in the LEVEL mode or percent distortion in the DISTORTION mode. The UNITS key to the right of the display chooses one of several available measurement units for a particular measurement function. These are grouped into LINEAR such as Volts, % or Watts and LOG such as dBV, dBm or dB. The choice between linear and log is a shifted function of the UNITS key. The unshifted UNITS key selects one from the available linear units or one from the available log units.

In the LEVEL modes the available units are Volts (including mV and $\mu$V), Watts (including mW and $\mu$W), dBm and dBV. Successive pushes of the UNITS key, both shifted and unshifted, will step through all four possibilities. In the DISTORTION modes only two units are available: % in the linear mode and dB in the log mode. Thus only the shifted operation of the units key has an effect.

The RELATIVE key to the right of the display allows the user to determine the ratio of the current measured value to a user chosen reference. For example, to determine the gain of a device, the ratio of the output level to the input level would be presented. Use of this feature is explained in more detail later.

The right hand display usually indicates the frequency of the INPUT signal. However, while data is being entered on the numeric keyboard, it will indicate the keystrokes as they are entered. When the data entry is complete, the display returns to its normal function of indicating INPUT frequency. (This display can also be switched to indicate the frequency of the internal oscillator or generator. In this case, an OSC legend will illuminate next to the display. See Special Function 37, Section 3.3.3, page 3-45.)

# 1.2 SPECIFICATIONS

All specifications apply to the basic system with option 201 High Performance Group and without options except where specified.

## 1.2.1 SIGNAL SOURCE

| | |
|---|---|
| Frequency range: | 10 Hz to 100 kHz |
| Frequency setting resolution: | 0.25% normal mode<br>0.005% fine mode |
| Frequency setting accuracy: | 20 Hz to 20 kHz : ±0.5%<br>10 Hz to 100 kHz: ±2.0% |
| Amplitude range: | 10 V rms to <1 mV rms open circuit |
| Amplitude setting resolution: | Maximum output to 1 mV: 0.03 dB or better |
| Generator off attenuation: | 10 Hz to 100 kHz: >100 dB, typically >130 dB at 1 kHz |
| Output amplitude accuracy (at 1kHz): | Maximum output to 1 mV: ±0.1 dB |
| Output amplitude flatness (maximum output to 1 mV): | 20 Hz to 20 kHz : ±0.1 dB<br>10 Hz to 50 kHz : ±0.2 dB<br>50 kHz to 100 kHz: ± 0.35 dB |
| Output source impedance : | 600 ohms, ±1% |
| Total harmonic distortion (passive notch/analysis method): The higher of: | 50 Hz to 10 kHz:<0.0005% (-106 dB)<br>20 Hz to 50 kHz: <0.003% (-90 dB)<br>10 Hz to 100 kHz: <0.01% (-80 dB) |
| Configuration: | Unbalanced, floating or grounded output |

## 1.2.2 ADDITIONAL SPECIFICATIONS for Option 001 High Level Balanced Output

| | |
|---|---|
| Output source impedance: (±1% ±1 Ω) | Balanced 600 Ω<br>Balanced 150 Ω<br>Unbalanced 50 Ω |
| Maximum output level: (at 1 kHz) | 600 Ω, open circuit : 33 V rms<br>600 Ω source, 600 load : +26.5 dBm<br>150 Ω source, 600 load : +30.0 dBm<br>50 Ω source, open circuit: 16.5 V rms<br>50 Ω source, 600 load : +23.5 dBm |

### 1.2.3 If option 007 Stereo Output is added, all above specifications apply for both A and B outputs.

Channel A to B isolation (crosstalk) 10 Hz to 100 kHz: >100 dB

### 1.2.4 ADDITIONAL SPECIFICATIONS for option 002 IMD

Frequency range,

| | | |
|---|---|---|
| | SMPTE mode: | HF 2 kHz to 100 kHz<br>LF 40, 50, 60, 80, 100, 125, 250 and 500 Hz |
| | CCIF mode : | Mean frequency: 2 kHz to 100 kHz<br>Difference frequency: 80, 100, 120, 160, 200, 250, 500, 1 kHz |

Amplitude mix ratio

| | | | |
|---|---|---|---|
| | SMPTE mode: | LF:HF | 1:1, 2:1, 4:1, 10:1 |
| | CCIF mode: | | 1:1 |

## ANALYZER SECTION

### 1.2.5 LEVEL & NOISE MEASUREMENT

| | |
|---|---|
| Frequency range: | 8.5 Hz to >500 kHz |
| Level range: | 100 V rms/+40 dBV to <10$\mu$V rms/-100 dBV |
| Level display resolution: | dBV, dBm : 0.01 dB<br>Volts, Watts : 4 digits |

Level accuracy (at 1 kHz using rms detector):

100 V/+40 dBV to 30 mV/-30 dBV: ±0.1 dB
30 mV/-30 dBV to 1 mV/-60 dBV: ±0.15 dB

Level flatness (relative to 1 kHz using rms detector):

100V/+40 dBV to 30 mV/-30 dBV, 20 Hz to 20 kHz: ±0.1 dB
100V/+40 dBV to 1 mV/-60 dBV, 10 Hz to 100 kHz: ±0.25 dB

Residual noise (wide band mode, rms detector):

Input ≤600 Ω, flat: <12.3 $\mu$V/-96 dBm
Input ≤ 600 Ω, 20 Hz to 20 kHz or "A" Weighting: <2.5 $\mu$V/-112 dBm

Residual noise (narrow band mode, rms detector):

Input ≤ 600 Ω, 1 kHz bandpass: <0.7 $\mu$V/-123 dBm

## LEVEL & NOISE MEASUREMENT (contd.)

CMRR 50 Hz to 20 kHz: >70 dB for inputs up to 2.5 V or +10 dBm

Input impedance: Balanced mode at 1 kHz:

100 k Ω ± 0.1% each side to ground
600 Ω ± 1.0%
150 Ω ± 1.0%

Input isolation (crosstalk channel A to B or B to A):

Both inputs ≤ 600 Ω, 10 Hz to 100 kHz: >130 dB

Detectors: true rms, average, quasi-peak

## 1.2.6 FREQUENCY MEASUREMENT

Range: 8.5 Hz to >500 kHz

Display Resolution: 5 digits

Frequency Accuracy: Better than 100 ppm

Minimum signal level for frequency measurement:

Level Modes: 1 μV/-120 dBV
Distortion and auto-tune narrow band modes: 30 mV/-30 dBV

## 1.2.7 THD + N MEASUREMENT

Frequency range: 9.5 Hz to 105 kHz

THD + N range: >32% to 0.0000% (>-10.0 dB to -120.0 dB)

Display resolution: 0.1 dB or 2 significant digits in %

Minimum input level for THD + N: 30 mV/-30 dBV

THD + N accuracy: 20 Hz to 20 kHz : ± 1 dB
10 Hz to 100 kHz: ± 2 dB

Fundamental rejection: the greater of 120 dB or 10 dB below highest harmonic

Residual THD + N (including 5500 generator and all error sources, signal level >300 mV rms)

50 Hz to 10 kHz, 30 kHz BW : <0.0018%/-95 dB
50 Hz to 10 kHz, 20 kHz BW : typically <0.001%/-100 dB
20 Hz to 50 kHz, 500 kHz BW : <0.005%/-86 dB
10 Hz to 100 kHz, 500 kHz BW: <0.01%/-80 dB

## 1.2.8 ADDITIONAL SPECIFICATIONS for Option 002 IMD (same as THD + N except as follows:)

| | | |
|---|---|---|
| Frequency range: | SMPTE | HF 3 kHz to 100 kHz<br>LF 40 Hz to 500 Hz |
| | CCIF mean | 4 kHz to 100 kHz |
| | difference | 80 Hz to 1 kHz |

Residual IMD (including 5500 generator)

SMPTE, 4:1 amplitude ratio: 3 kHz to 10 kHz : <0.003%/-90 dB
10 kHz to 100 kHz: <0.01%/-80 dB

CCIF 4 kHz to 10 kHz: <0.001%/-100 dB

## 1.2.9 FILTERS

Standard filters:

400 Hz high pass: 60 dB per decade, Butterworth response
30 kHz low pass : 60 dB per decade, Butterworth response
80 kHz low pass : 60 dB per decade, Butterworth response

SPCL filter:

One of the following : ANSI/IEC "A" Weighting (standard)
CCIR 468-3 (option 101)
Psophometric CCITT P53 (option 102)

Optional filters: See ordering information.

## 1.2.10 IEEE-488 INTERFACE FUNCTION SUBSET

SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP0, DC1, DT1, C0

## 1.2.11 PROGRAMMABILITY

All front panel functions may be controlled via the external interface. All measured values may be read via the external interface formatted in the same modes available from the front panel. Up to 10 instrument setups may be stored in non-volatile internal storage. The instrument powers up in a factory predetermined default state and the user may easily recall the previous state that was present at power down.

## 1.2.12 INTERFACE

The instrument is supplied with an IEEE-488 GPIB Interface as standard. An optional RS232 Serial Interface capability may also be supplied. (EIA RS232C specification: 9600 baud, full duplex, jumper configures as DCE or DTE, X-on, X-off handshake, no parity, 8 data bits, 1 stop bit.)

## 1.2.13 GENERAL SPECIFICATIONS

| | |
|---|---|
| Readings per second: | >2.5 typical<br>>3.5 with option 200 |
| Temperature range : | Within specification: 25°C ± 5°C<br>Operation 0°C to +50°C<br>Storage -20°C to +60°C |
| Power requirements : | 100, 120, 220, 240 V AC +5% -10%<br>48 Hz to 66 Hz 150 VA maximum |
| Weight : | 45 lbs/20.5 kgs maximum |
| Dimensions: | 7.5 in. H x 16.5 in. W x 20.25 in. D<br>(19.1 cm x 419 cm x 514 cm) |

All specifications subject to change without notice.

## 1.3 INPUTS AND OUTPUTS

The instrument provides both balanced and unbalanced inputs, unbalanced and optionally balanced output(s). All unbalanced inputs and outputs, monitors and auxiliary inputs and outputs on the rear panel are industry standard BNC connectors for coaxial shielding, reliability and ease of use. All balanced inputs and outputs use telephone style (or military style) tip-ring-sleeve phone jacks. These require mating telephone (military) style phone plugs such as WE310 or PJ051. Do not use the similar but different stereo headphone style phone plug. They will not make proper contact and will damage the jacks. The telephone style connectors have a special design to avoid momentary shorting during insertion and removal and achieve long, reliable life. The tip and ring have different dimensions than the "stereo" style connectors.

Telephone style plug-to-banana binding post adapters are available from Amber and various cables and adapters with this style of plugs are available from the popular suppliers of this equipment (Pomona, Switchcraft, ADC, etc.).

The following pages show simplified diagrams of the input, output and grounding structure in the 5500 to assist in interface to external equipment.

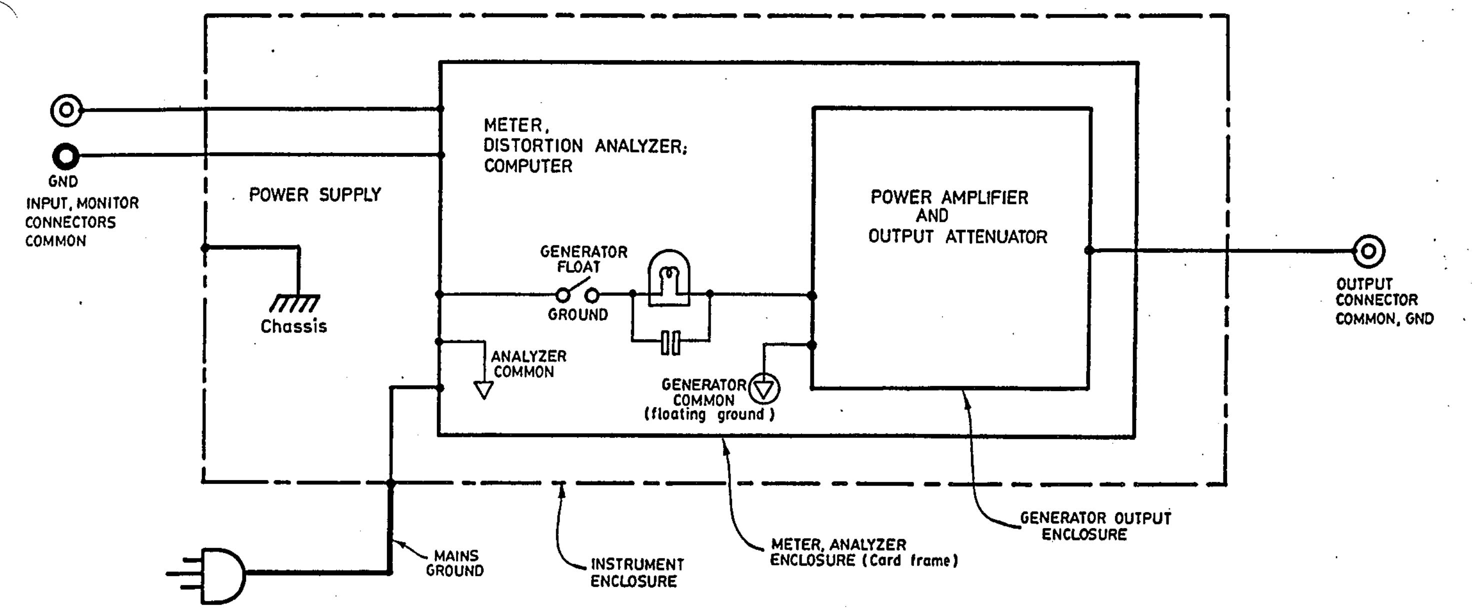
## 1.4 OPTIONAL FEATURES

In most cases, the 5500 main frame is wired for most available options even if they have not been purchased. Similarly, the front panel may contain pushbuttons for features not resident in the instrument. This is done to facilitate field installation and upgrade of instruments.

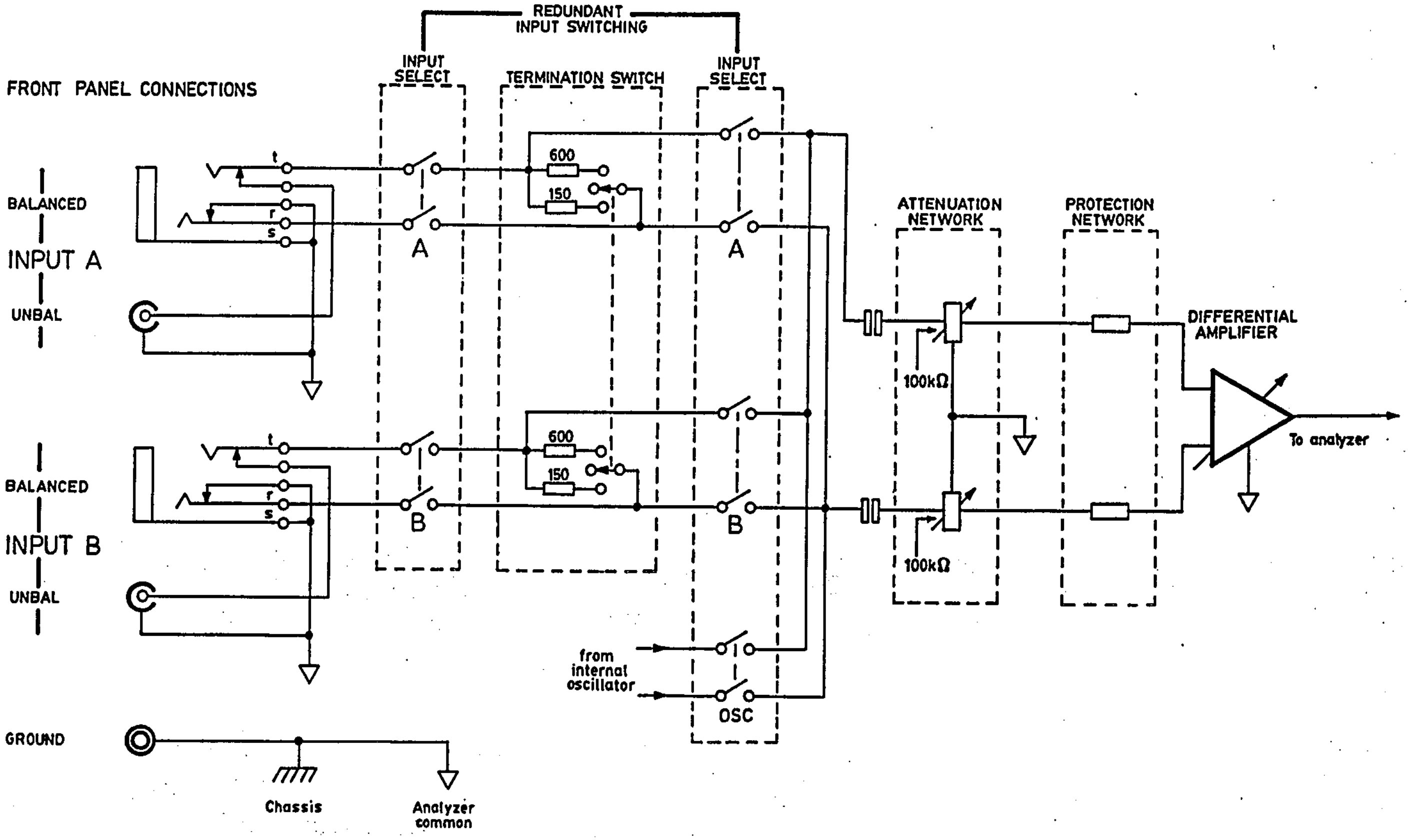
To determine the options present in a particular instrument, check the five digit option code against Chart 1.5 following. The five digit option code may be found on the instrument serial number plate located on the rear panel of the instrument. The MODEL number box on this plate will show a 9 digit number: 5500-XXXXX where the suffix XXXXX represents the option code for the instrument. For example, 5500-00000 is an instrument without any options while 5500-13100 would be an instrument with options 001, 002 and 005.

Although certain options may not be resident in the system, pushing the associated button will have no effect. That is, the buttons are not inhibited if the option is not installed. The resulting readings shown on the display will, of course, be meaningless.

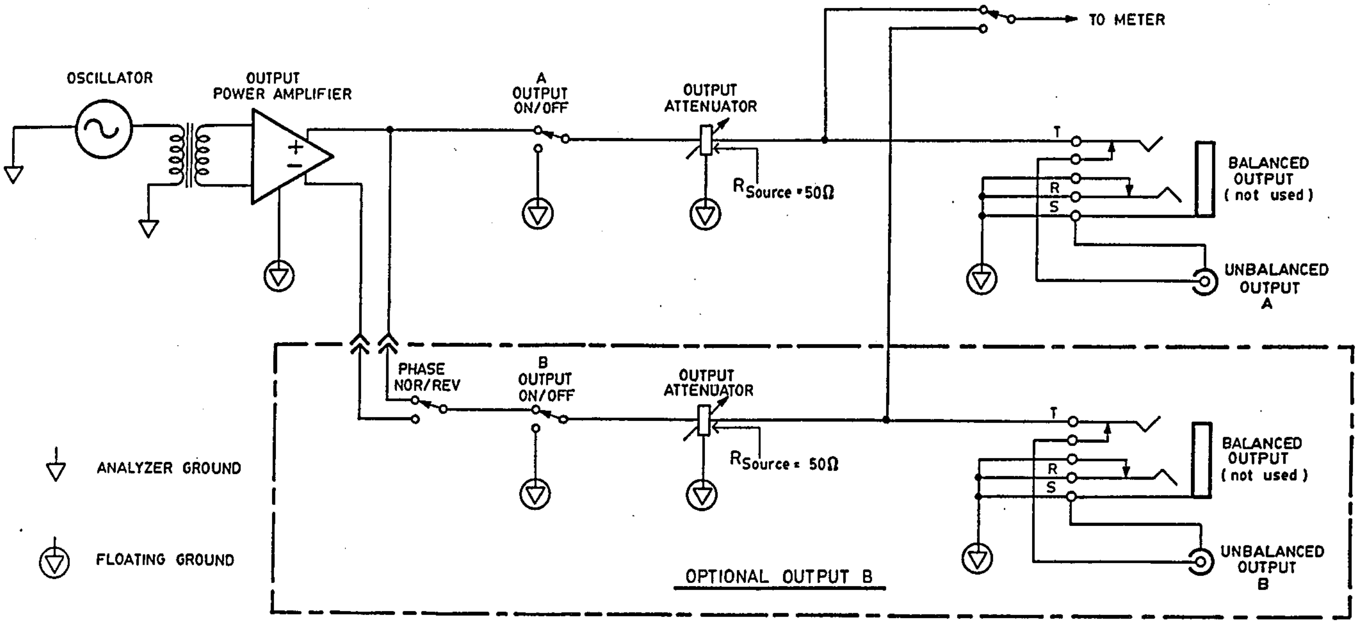
The same condition is true of input/output connectors. Output B is an option (007) which may or may not be present, yet the output jacks will always be present as will the output pushbuttons and indicators. However, no signal will be found on this jack without the addition of the internal module necessary to provide this function.


GND
INPUT, MONITOR CONNECTORS COMMON
POWER SUPPLY
Chassis
METER, DISTORTION ANALYZER; COMPUTER
GENERATOR FLOAT
GROUND
ANALYZER COMMON
GENERATOR COMMON (floating ground)
POWER AMPLIFIER AND OUTPUT ATTENUATOR
OUTPUT CONNECTOR COMMON, GND
MAINS GROUND
INSTRUMENT ENCLOSURE
METER, ANALYZER ENCLOSURE (Card frame)
GENERATOR OUTPUT ENCLOSURE

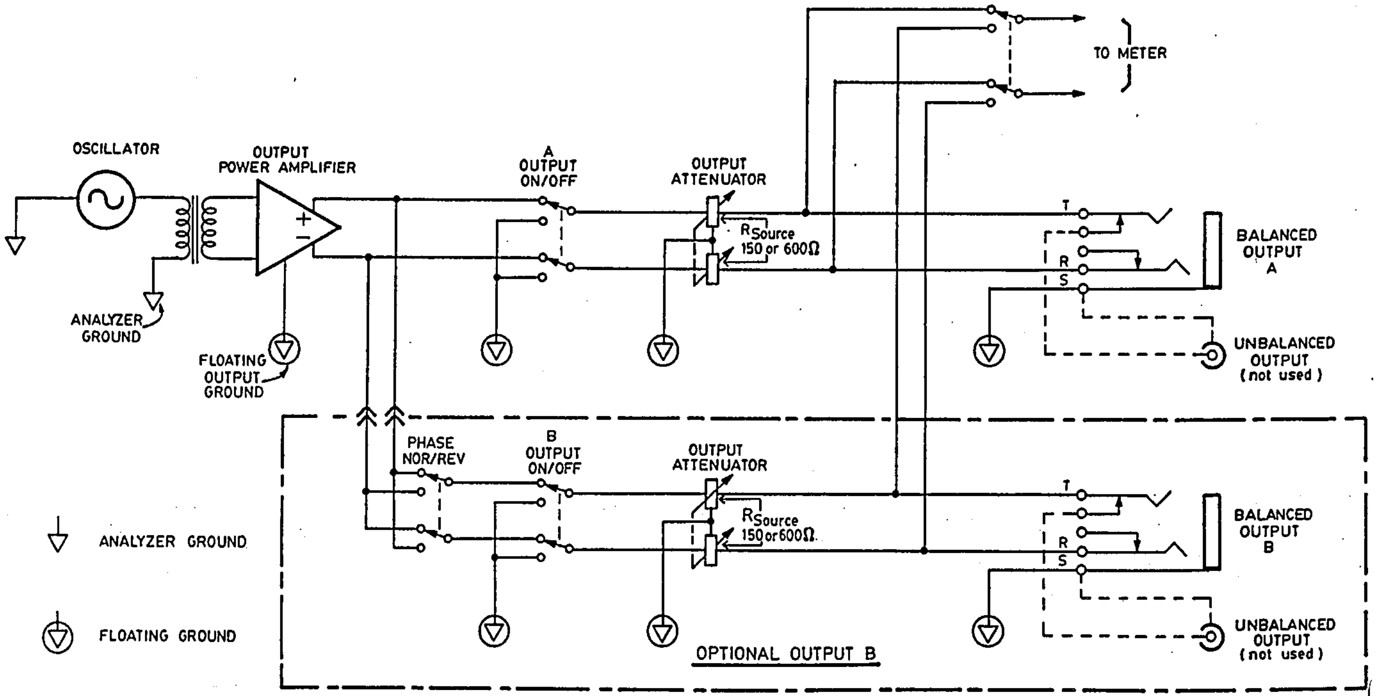
SHIELDING AND GROUNDING SIMPLIFIED



SIMPLIFIED INPUT STRUCTURE



SIMPLIFIED OUTPUT STRUCTURE
UNBALANCED MODE

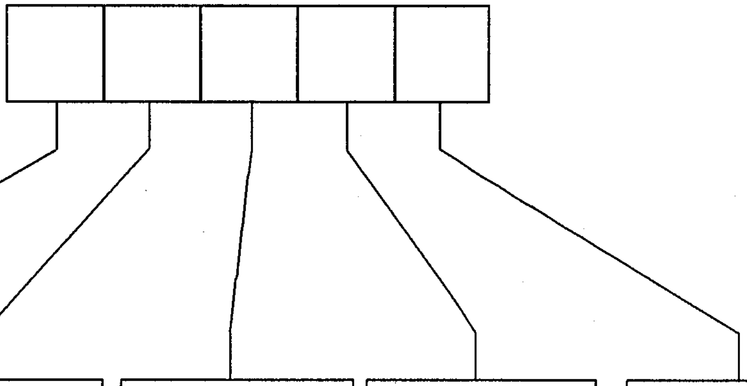


SIMPLIFIED OUTPUT STRUCTURE
BALANCED MODE

## 1.5 OPTION DECODE CHART

### 5500 OPTION ORDERING CODE

**5 5 0 0 -**



| | GENERATOR FEATURES | WEIGHTING FILTERS | MEASUREMENT FEATURES | SPECIAL FEATURES | INTERFACE & CPU |
|---|---|---|---|---|---|
| 0 | None | ANSI A | None | None | 488 only |
| 1 | 001 | 101 | 002 | 054 | 488+232 |
| 2 | 001+007 | 102 | 008 | 201 | 488+200 |
| 3 | | 005 | 002+008 | 201+054 | 488+232 +200 |
| 4 | | 006 | 009 | | |
| 5 | | 005+102 | 008+009 | | |
| 6 | | 006+101 | 002+008 +009 | | |
| 7 | | 006+102 | 002+009 | | |
| 8 | | 056 | | | |
| 9 | | Custom | | | |

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